Mid-Term Examination

Time: 07:00 p.m. - 08:30 p.m.

Instructions: Candidates are to answer all four questions
This is a closed book exam

a) 18.4 cm
b) 0.516 cm
c) virtual, upright

1.(4%) A thick lens shown in Figure 1 has front (back) surface radius of 3 (5) cm. The thickness of the lens is 2 cm. It is made of glass with n=1.3. A person is using this lens to watch an object located 5 cm in front of the front surface. An observer's eye is 15 cm behind the back surface of the glass as shown in Fig. 1. Using the thick lens approach, calculate (a) the position of the image and its distance to the observer's eye (b) the size of the image if the object is 1 cm tall. (c) determine whether the image is real or virtual, upright or inverted(justify your conclusions).

2. (4%) (a) An object is placed 20 cm in front of a concave mirror with the radius of curvature of 30 cm. Find the position of the image by the matrix approach ~~(the matrix~~ B method). Explain the meaning of the steps in your solution.

a) $\boxed{-60\ \text{cm}}$

(b) An ~~object~~ image is formed 2 cm in front of a thin biconvex lens with the radius of curvature of 5 cm. The refractive index of the glass is 1.5. Find the location of an object by the thin lens equation in the Newtonian form.

q = -1.43 cm (f = 5cm)

3. (3%) A person has a far point of 50 cm and a near point of 15 cm. What power eyeglasses (in Diopters) is needed to correct the far point (explain)? Using the eyeglasses, what is the person's new near point (explain)?

$\boxed{-2D}$ $\boxed{21.4\ \text{cm}}$

(b) When you look at somebody across a log fire, his/her features waver. Explain the phenomenon.

4. (3%) (a) A microscope has an objective lens with a focal length of 4 mm and an eyepiece with a focal length of 3 cm. If the object being viewed is 4.1 mm from the objective lens, (a) how far should the eyepiece be from the objective lens in order for the virtual image formed by the eyepiece to be viewed with accommodation, and (b) what is the magnification of the microscope?
(b) Explain the concept of f-number. Where and how is it used?

$\boxed{-333X}$

19.1cm

$c_w = \lambda\nu$; $n = c_{vac}/v_{med}$; $\lambda_{med} = \lambda_{vac}/n$; $S = Ln$; $L' = L/n$; $\angle I = \angle R$; $n sin\theta = n' sin\theta'$; $\frac{n_{prism}}{n_0} = \frac{\sin(\frac{D+A}{2})}{\sin\frac{A}{2}}$; $D = (n-1)A$; $\frac{1}{S_o} + \frac{1}{S_i} = \frac{1}{f}$; $f = \frac{R}{2}$; $m_T = -\frac{S_i}{S_o}$; $P = \frac{n'-n}{R}$; $\frac{n}{S_o} + \frac{n'}{S_i} = \frac{n'-n}{R}$; $m_T = -\frac{nS_i}{n'S_o}$; $n_{med}/f_{lens} = (n_{lens} - n_{med})(\frac{1}{R_1} - \frac{1}{R_2})$; $m_\theta = tan\theta'/tan\theta$; $m_\theta = P/4 = 25/f$; $m_\theta = 1 + P/4$; $m_x = m_T^2$; $x_o x_i = f^2$; $\frac{1}{f} = (n-1)\left[\frac{1}{R_1} - \frac{1}{R_2} + \frac{(n-1)d}{nR_1R_2}\right]$; $h_1 = -\frac{f(n-1)d}{R_2 n}$; $h_2 = -\frac{f(n-1)d}{R_1 n}$; $m_T = -\frac{i}{o} = -\frac{x_i}{f} = -\frac{f}{x_o}$; $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$; $P_{eq} = P_1 + P_2 - P_1P_2d/n$; $h_1 = \frac{fd}{f_2}$; $h_2 = -\frac{fd}{f_1}$; $d = (f_1 + f_2)/2$; $m = -\frac{f_0}{f_E}$; $d = f_0 \pm f_E$; $m = -\frac{T}{f_0}\frac{25}{f_E}$; $m = -i'/f_E$; $m = -i'/X$; $\hat{R} = \begin{vmatrix} 1 & -P \\ 0 & 1 \end{vmatrix}$; $\hat{T} = \begin{vmatrix} 1 & 0 \\ d/n & 1 \end{vmatrix}$; $\hat{A} = \begin{vmatrix} 1 - P_2 d/n & -P_1 - P_2 + P_1P_2d/n \\ d/n & 1 - P_1 d/n \end{vmatrix}$; $\hat{M} = \begin{vmatrix} -1 & 2n/R \\ 0 & 1 \end{vmatrix}$

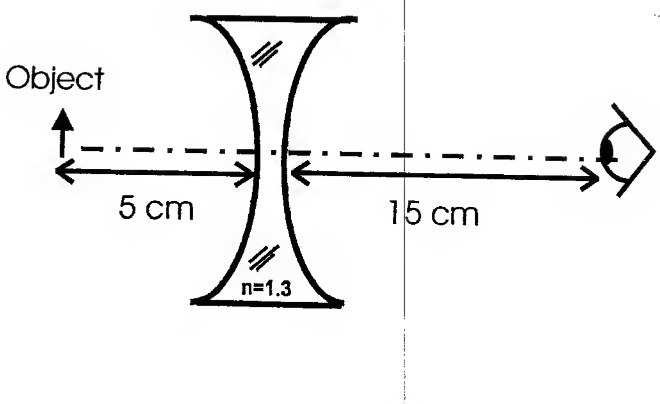
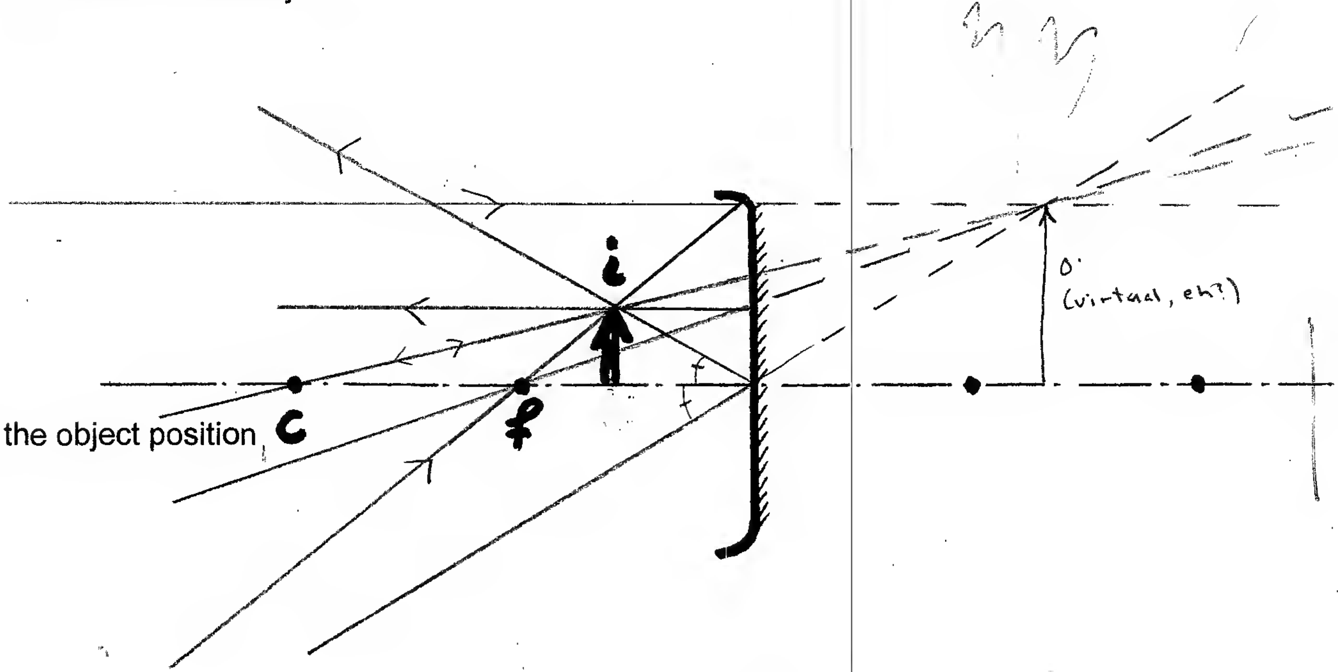


Figure 1.

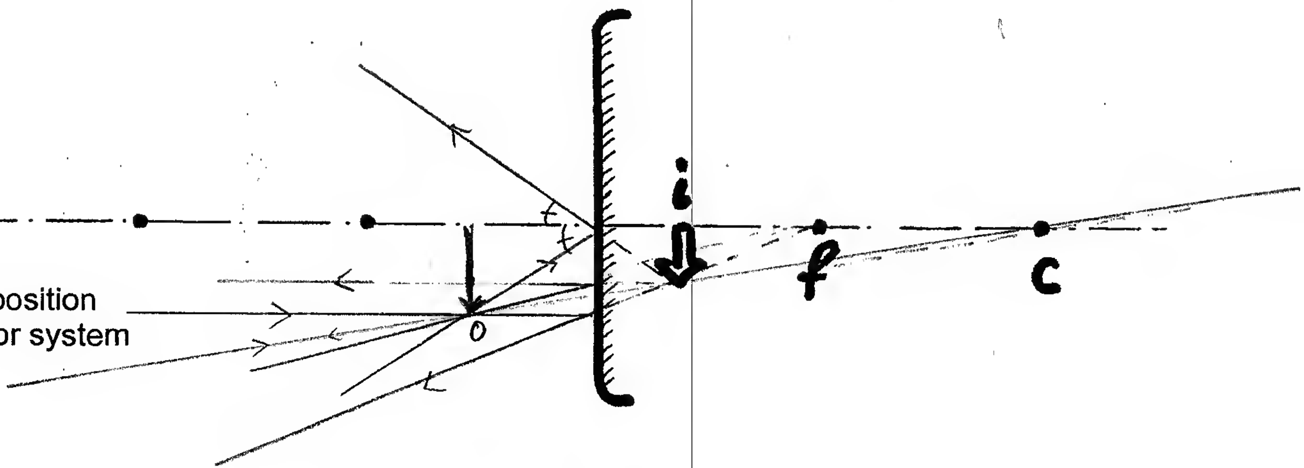
Quiz#1: Images in Mirrors

All four rays (parallel, focal, chief and vertex must be shown)

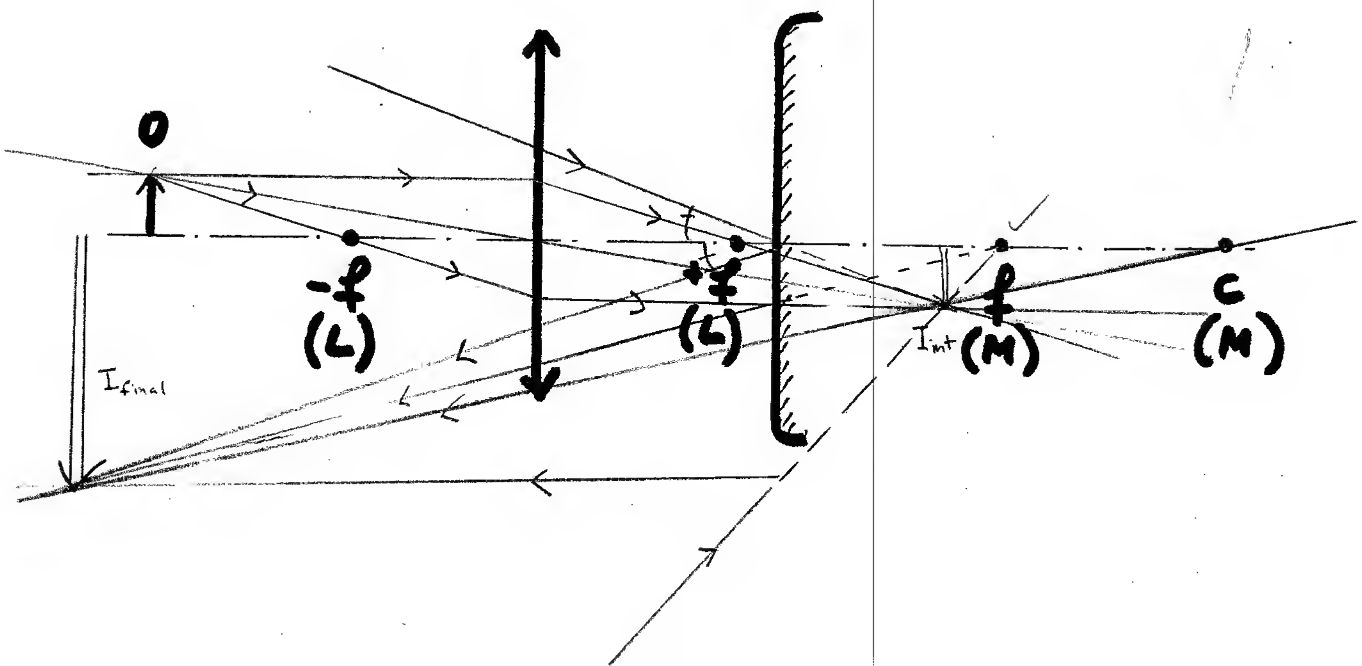
Find the location of an object



Find the object position



Find the image position
for the lens-mirror system



Quiz#2: Images in Lenses

All three rays (parallel, focal and chief) must be shown

Find the location of an image for all three cases